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DISEASES OF THE NERVOUS SYSTEM

A PRACTICAL JOURNAL ON PSYCHIATRY AND NEUROLOGY

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DISEASES of the NERVOUS SYSTEM

A PRACTICAL JOURNAL ON PSYCHIATRY AND NEUROLOGY

Sodium Amytal Narcosis, with Delirium, as A Therapeutic Method

EUGENE J. ALEXANDER, M.D.
Detroit, Michigan

Bleckwenn[1] reported in 1930 on the use of Sodium Amytal in the treatment of various psychiatric conditions. His method consisted of the use of one intravenous dose of 7 to 25 grains in each 24 hour period for "several weeks." In thus re-establishing a periodicity of sleep, beneficial results were obtained, particularly in manic conditions, and in agitated depressions. Palmer[2] in 1932 reviewed the use of prolonged narcosis by other authors and reported 26 cases of his own. Several different sleep producing agents were used in that series, but he finally settled on Sodium Amytal, and in 1937 he[3] reported 100 cases treated for 5 to 22 days with this drug. In his earlier series, 40 to 60 grains per day was the average dose, and dosage of 90 to 120 grains was not uncommon; it is presumed that this dosage characterized the later series also. While his results in the psychoses were good enough to be interesting, the treatment method was neither as convenient, as safe, nor as effective as convulsive therapy, which was appearing on the scene at that time. In this series of 100, there were only five cases of psychoneurosis, but four of these gained good therapeutic results, although convulsive therapy in psychoneurosis has been generally disappointing.

Heldt[4] began, in 1938, to use Sodium Amytal narcosis therapy according to Palmer's method, but with two significant differences; he applied the treatment mainly for psychoneurosis, rather than for psychosis and further instead of avoiding the physical and mental symptoms of a delirioid nature, as Palmer did by gradual reduction in the Sodium Amytal dosage, Heldt set out deliberately to cause those effects, on the theory that delirium is a therapeutic experience. His original report, in 1947, was based on 171 cases between 1938 and 1946 inclusive. Between 1947 and 1951 an additional 153 cases have been treated under his general direction and he has made additional contributions to the literature.[5] The present author has been a clinical associate of Dr. Heldt since 1946, has learned the treatment method from him, has been in close contact with the cases treated since then, and has had access to the records of those treated before 1946. The present report is a statistical summary of the total 324 cases between 1938 and 1951, inclusive; and although the opinions expressed herein are those of the author, it is obvious that Dr. Heldt has been the teacher and the inspiration throughout the work.

Method

The direct effect of the treatment upon the patient has been described in the aforementioned references and in an article by the present author.[6] In that article I express my opinion that the constant presence in the body of Sodium Amytal, in an average dosage of about 60 grains per 24 hours, for seven to 12 days, creates a state of physio-

From the Division of Neuropsychiatry, Henry Ford Hospital, Detroit, Michigan.

logic dependence upon the drug. During the days of drug administration, the patient is narcotized almost continuously, although it gradually takes more and more of the drug to keep him so. It is my opinion that the body during that time is creating some sort of biochemical defensive "counter-adaptation" to the drug and that the results which follow the abrupt discontinuance of the drug are the result of the unopposed action of this "counter-adaptation" substance. Its effects are the exact opposite of the physical and mental rest induced by Sodium Amytal: physical and mental unrest and irritability, manifested by insomnia, muscular tremors, and hallucinations, and in about 10 per cent of cases, one or more generalized convulsions. The insomnia and the tremor disappear in about three days. Generally the mental symptoms disappear at the same time; that is, when the patient sleeps again (spontaneously, of course, no sedative being given at this time), the patient usually loses his hallucinations and delusions. However, this is not always so. Delirioid mental symptoms, a sort of induced psychosis, may continue for several more days, and in a rare case up to two weeks. When the mental and the physical effects of the treatment have disappeared, almost all of the patients are then considerably better, not only in comparison to their very acute discomfort during the delirium, but also in comparison to their original condition for which the treatment was administered. In favorable cases, those in which this initial improvement does not immediately disappear, the patient will stay in the hospital for about five days longer for rest and convalescence; he will then usually require a period of two to six weeks for convalescence, on a vacation trip, with relatives, or at home, before assuming his customary responsibilities.

Results

The over-all improvement rate in the 324 treated cases is only 48 per cent (Table 1); but the treatment has been given, in order to gain experience with it, in some cases where there was only slight hope that it might help which weights the statistics unfavorably. When we consider only psychoneurosis (Table 1), the improvement rate is somewhat better, 57 per cent of 205. In the period from 1938 through 1946 the treatment was new and our results since 1947, both from stricter choice of cases and from more experience with the method, are somewhat better: 52 per cent of 153 total cases improved, 60 per cent improved in 99 cases of psychoneurosis (Table 2). In these tabulations, the word "improved" has not been used to include those cases which had only slight or temporary (less than nine months) benefit. Had it been used so loosely, I could have claimed that 92 per cent, instead of 57 percent of the psychoneurotic patients were helped, but that would not have been a realistic way of handling the statistics in a treatment as arduous as this one.

It should be understood that we have given this treatment only to chronically ill, seriously disabled patients who did not respond to other forms of psychiatric therapy. However, even in that type of psychoneurotic patient, 57 per cent improved leaves much to be desired; and one may raise a serious question as to the value of the treatment, considering that it is not easy to administer, and major and minor complications are frequent. However, it is not enough to dismiss the treatment method by simply stating that it is less effective and more dangerous than electro-convulsive therapy and therefore has no place. This is essentially true in the psychoses but not in the psychoneuroses; we even have a few cases (13) of affective disorders who had had ineffective ECT but who improved with Sodium Amytal narcosis. Those cases might be skeptically dismissed with the suggestion that either the ECT had not been vigorously enough pursued, or that the improvement after Amytal came about because the cyclic disorder just happened to be ready to go into remission. I am not satisfied with that explanation, but will not press the point, for I myself certainly would choose electroconvulsive therapy in any affective disorder. The burden of this paper, beyond presenting the facts of our experience with the procedure, is to analyze our experiences critically, particularly with reference to psychoneurosis, in order to determine: 1) Whether there are some cases seriously enough disabled to make the complications worth risking, who cannot be

TABLE 1

	Improved	Unimproved	Total
Psychoneurosis	116 (57%)	89 (43%)	205
Affective psychosis	14 (38%)	23 (62%)	37
Paranoid and Schizophrenia	10 (19%)	44 (81%)	54
Miscellaneous	16 (57%)	12 (43%)	28
Total treated	156 (48%)	168 (52%)	324
Stopped by complications			13
Deaths		(1½%)	6
Total treatments begun			343

TABLE 2

	Before 1947			1947-1951		
	Improved	Unimproved	Total	Improved	Unimproved	Total
Psychoneurosis	57 (54%)	49	106	59 (60%)	40	99
Other cases	19	46	65	21	33	54
Total	76 (44%)	95	171	80 (52%)	73	153

TABLE 3

COMPLICATIONS IN 343 TREATMENTS BEGUN

	Severe: Interrupted treatment	Without stopping treatment	Mild	Died	Total
Respiratory irregularity and blood pressure drop	3	4		1	8
Lacerations and other injuries	2	13			15
Fever from pulmonary congestion	6		23		29
Vomiting	2				2
Cystitis			2		2
Fecal impaction			1		1
Torsion contractions during narcotic time			1		1
Compression fractures		2			2
Aspiration of vomitus				1	1
Pulmonary embolism				1	1
Post-amytal toxicity				3	3
Totals	13	19	27	6	65
	(3.8%)	(5.6%)	(7.9%)	(1.5%)	(18.7%)

DEATHS

1. R.A. Respiration stopped while being given Sodium Amytal intravenously.

2. M.G. Autopsy showed pulmonary embolism, source not found.

3. W.G. Died from aspiration of vomited material in 76th hour of treatment. He had expressed passive obstructionism, had done voluntary regurgitation and expressed suicidal wishes before treatment. It is possible that this regurgitation and aspiration during treatment was a voluntary suicidal attempt.

4, 5, and 6. These three cases (MG, PM, and WS) all died in a similar manner, approximately 24 hours after discontinuance of the amytal. They had regained a conscious, very hyperexcitable state, with constant restless movement, and pseudo-convulsive jerkings. Death probably resulted from exhaustion as a direct result of the toxicity of the withdrawal syndrome. Autopsy was secured in only one of these three cases, and it showed some aortic sclerosis. Another of these cases was known to have marked arterial hypertension and hypertensive heart disease.

helped as effectively by a simpler and safer therapy, and 2) to consider theories as to why it has worked, physically or emotionally in the hope that such an analysis will lead us to truths which may be therapeutically applied in other ways.

Complications

How frequent and how serious are the complications? (Table 3.) Out of 343 cases begun on the treatment, six died, a mortality of 1.5 per cent, and that, of course, is enough to give one pause. Excluding the deaths, the treatment was discontinued, before it could be therapeutic, in 13 cases (3.8 per cent) because of complications—drop in blood pressure, respiratory irregularities, and high fever based on pulmonary congestion. An additional 19 cases (5.6 per cent) had moderately serious complications during or after the treatment but not severe enough to interrupt the treatment. These were mainly injuries occurring before we learned to use safe-guards on the narcotized patient. The patient would try to get out of bed and would fall. Most of these injuries were lacerations of no permanent significance but the possibility of serious injury was great. We tried to solve the problem by placing the patient on a mattress on the floor. While this made serious injury less likely, it did not prevent bumps and bruises. More recently we keep the patient in bed with a wide belt about the torso, loose enough to permit him to turn but not to get out of bed. With hands and legs free, the patient does not find this type of restriction uncomfortable and it has solved the problem of the patient injuring himself.

In Table 3 I have shown an additional 27 cases in which the "complication" was not

serious at all—a mild fever, urinary retention, etc. I have not, however, shown the incidence of convulsions because we have not considered it a complication, but rather a therapeutic incident, in the same way in which it is therapeutic in electroconvulsive therapy. We had 29 patients (of 324—9 per cent) who had convulsions in their post-amytal period. Eighteen of these 29 patients (62 per cent) were improved by the total treatment which is somewhat better than the over-all improvement rate (48 per cent), tending to support our impression that the convulsion is not harmful and may be in fact therapeutic. However, these convulsions may, like ECT, cause vertebral compression fracture (2 cases); and since these convulsions may, unlike ECT, occur when the patient is unattended, the possibility of an injury from a fall is present. Three of our deaths occurred in the post-amytal state in association with convulsive twitchings, but we considered that the death was the result of the general hyperkinetic state rather than the direct result of the convulsion. Recently a similar case occurred (not included in this statistical analysis) which we were able to save by administering barbiturates to reduce the severity of the post-amytal reaction. The significantly dangerous thing we see is not the convulsive movement, but the underlying brain metabolic condition we have induced, the withdrawal syndrome, which may be serious enough in and of itself to cause death. The barbiturate we administered in this case saved her life, not alone because it stopped the muscular movements, but because it probably was an antidote to the "counter-adaptation" substance the brain cells had formed.

In summary, the way we now feel about the complication risk we run in giving this treatment is as follows: Oral administration of the medicine in increments of six grains every two hours (raised to 9 grains in most cases near the end of the treatment) is safer than intravenous administration; for as long as the patient is awake enough to swallow, the additional 6 or 9 grains is not going to put him into dangerous respiratory embarrassment. The problem of lacerations and injuries is satisfactorily solved now by the use of the loose torso belt. Finally, we now feel that we can recognize a dangerous degree of toxicity in the post-amytal state and by administering barbiturates reduce the degree of the reaction to a safe point. With these things in mind, plus our routine precautions (liquid diet to prevent aspiration of solid food in case the patient vomits, penicillin if patient shows a tendency to fill up with mucus in the lungs, adequate fluids, and good nursing care) we feel that the treatment can be given safely.

Theoretical Discussion

This treatment has not been given to mildly ill patients. We have been dealing with a group of persons, not really suitable for state psychiatric hospital care, and yet resistive to ordinary methods of therapy, and seriously disabled for long periods of time. Very few of our patients had been ill for less than a year; and by the word "ill" I mean unable to carry on even a small amount of useful work, grossly uncomfortable almost continuously, and so emotionally disturbed as to create a trying situation for all concerned. In many instances the patient had had intensive psychiatric treatment, including psychotherapy, analytic and otherwise, for as long as five years, before coming to us. Furthermore, if treatment by qualified psychiatrists had not been tried before we saw the patient, we would invariably ourselves give psychotherapy for whatever length of time seemed clinically desirable before recommending amytal-delirium therapy. Social factors necessarily enter, such as distance patient lives away from a psychiatrist, and the high cost of psychotherapy when it must be given in a hospital setting.

When the psychiatrist is dealing with a psychotic patient who fails to respond to his therapy, social pressures force removal to a state hospital. This takes from the family the financial burden of treatment of his illness, and lessens their daily disappointment over the fact that there is no visible improvement. Once he is in a public institution, if he gets better eventually, good; but if he doesn't, or if it takes him years to do so, others can begin to adjust their lives to the idea of going on without him. Such a solution of the social pressures and method of escape for the psychiatrist in private

practice does not exist in dealing with psychoneurosis. If the patient doesn't get better, the social pressures keep constantly getting worse. With this treatment, in three or four weeks' hospitalization, we have succeeded in about 60 per cent of cases in getting patients back to functioning, who without the treatment might well have required an additional four to six months of sanitarium care. This seems to me to make the treatment worth while, unless or until some simpler, more effective, and less dangerous method of achieving the same end is available.

Perhaps we may approach the search for that better treatment by considering some theories as to why the amytal-delirium method has worked. I will discuss the following ideas: 1) That the simple sedation afforded by the narcotic period of the treatment is the effective agent. 2) That it is a method of physiological discharge of tension analogous to electroconvulsive therapy. 3) That the delirium itself is the therapeutic agent. 4) That the unpleasantness of the treatment is what makes it effective, and 5) That it provides a means of facing and surmounting basic fears.

Sedation and Psychotherapy?

It may be suggested that the very deep narcosis, followed by delirium, are unnecessary features of the treatment; that the same results could be achieved by simple sedation and psychotherapy. It is well known that Sodium Amytal will quiet anxiety and make the patient more accessible to psychotherapy and more uninhibited in divulging significant material. Perhaps if this agent were used in dosages large enough to make the patient comfortable for several weeks his morale would be sufficiently improved and his rate of progress in psychotherapy more rapid, so that distinct therapeutic gain would result. Considering the severity of the patients we have treated and the fact that they came to amytal-delirium therapy only after failure of ordinary psychotherapy, it seems unlikely that the addition of heavy sedation would make much difference. However, we intend to make a comparison study.

Discharge of Tension?

One might draw an analogy between this therapy and electroshock. Electroshock causes a convulsion, which may be conceived of as a discharge of "tension"—a state of activation in certain neurons—by the transmission of that activation to other neuron systems, which in turn discharge their tension through the activation of muscles. This treatment causes a delirium which may be conceived of as a discharge of that same original internal tension through activation of neuron systems serving the function of thought association. In this mechanical way, both treatments may function by restoring a homeostasis which has been lost. If this were the mechanism of action, the treatment would have no place, unless it could be shown that there are some kinds of tension within the nervous system which cannot be discharged through the motor system but can be discharged through the association pathways. I have not been able to define and distinguish just what kinds of tension that would be, even by examining in detail the cases which failed to respond to ECT but did respond to narcosis. Therefore, as a means of relieving tension, by which I mean restoring affect to its normal balance, ECT is still to be preferred.

In connection with the relationship of this therapy to ECT one interesting situation did develop which deserves mention. In a few cases the delirium is prolonged considerably beyond the usual three or four days and in four of the 153 cases with which I have been personally acquainted the delirium continued beyond 10 days. We became worried about this psychosis we had induced in patients who were psychoneurotic before treatment, but were relieved to find that we could interrupt this induced psychosis at will, by one to three ECT's. One wonders how long this induced psychosis would continue if nothing were done but I have not had the fortitude to allow it to continue beyond two weeks. The situation is similar to the joke about the common cold: the doctor says, "I can't do anything for your cold, but get pneumonia and I can cure that." We know too little what to do for psychoneurosis but turn it into a psychosis and we can cure that. That's essentially what we do with this treatment, except that nature herself almost always cures the psychosis we induce before we need to do so with ECT.

This experience with prolonged delirium is cited primarily to indicate that the amytal-delirium treatment is not effective in the same way as ECT for, in these cases at least, instead of the treatment doing the same thing ECT would do, it did something which ECT could un-do.

Delirium As Therapy?

We come now to a discussion of Heldt's original theory, that delirium is a therapeutic experience. If this is correct, then there should be a correlation as follows: the longer the delirium lasts, the greater improvement should occur; and, conversely, in those cases which had a very mild delirium, the improvement rate should be poorer. However such a statistical correlation is not possible from this material. In the first place, the number of cases of delirium prolonged beyond three days is too few, and the other variables (such as clinical diagnosis) are too many to permit conclusions to be drawn by comparing degree of improvement to the number of days of delirium. The converse proposition, concerning patients who had little or no psychic disorganization in their post-amytal period, is also not statistically significant. We had 40 such cases, without much delirium, and 17 of these (43 per cent) nevertheless ended up in the "improved" column. That is so little different from the general improvement rate of 48 per cent that it is only weak support for the theory.

Perhaps delirium may have been present in some cases for longer than it was recognized and tabulated in our records; for the patient who is in a delirium may have an ebb and flow in his contact with reality, and so the examiner may happen to see him in a lucid interval, or may, if he is inexperienced, miss a phrase or gesture which exposes the fact that delirium is still present. At any rate a clinical impression does remain, although not adequately supported statistically, that the therapeutic gain from the treatment is roughly proportional to the severity and duration of the delirioid mental disorganisation. Palmer[3] wrote: "The form of treatment which was most debilitating and produced the greatest degree of toxemia and physical prostration resulted in the largest number of recoveries," and Heldt[4] thought that the treatment's effect was to disorganize the patient's personality paterns, and then nature's spontaneous "remobilizing is always in the direction of normalcy." However, these ideas do not prove that delirium, specifically, is beneficial—rather they suggest that any serious threat to the ego, carried out in the name of treatment, may be beneficial; this, of course, suggests that we examine the psychological setting in which this threat to the ego is given.

Flight Into Health?

Considering these psychological factors it might be cynically presumed that we frighten the patient out of his symptoms—like hitting oneself over the head with a hammer, it feels so good when you stop. There is no doubt that the delirium is an unpleasant experience. We know, of course, that hysterical patients may lose their symptoms under punishment or threat but with further disorganization of their personality. No psychiatrist recommends that. Hysterical patients may also give up their symptoms under unpleasant treatment by a doctor who stands by to help them solve the conflict causing the symptoms, the conflict becoming more apparant as the protective value of the symptoms is lost. This method of dispelling the disabling symptom is ethical therapeutics. An observation bearing out this theory is that almost all the patients, for at least a few days after the delirium has passed away, feel considerably better, not only in comparison to their acute discomfort during the delirious period, but also in comparison to the condition for which the treatment was given. It is as if the severe threat to the ego, given by the treatment, has caused all lesser matters, including the psychoneurosis, to fade into the background. However, the fact which makes this theory inadequate to explain the lasting improvement in many patients, is that these patients often do not need a great deal of psychotherapy afterward. If the illness is a flight from reality, and then because the treatment is unpleasant, he makes a flight back to health and reality, psychodynamically one would expect a new flight into illness in a short time. I therefore cannot accept this explanation for the improvement.

Facing Basic Fears?

A more logical explanation of the psychological effect is that the treatment provides a method of facing and surviving certain basic fears and undergoing an experience which points up the fallacy in his basic neurotic attitudes. For example, the fear of insanity is frequently a focus for the anxiety the psychoneurotic patient feels. Admittedly, it is not the source of the anxiety, rather it is a symbol very close to the basic complexes. I refer specifically to this triad of false ideas which is constantly exemplified in neurotic thinking and behavior. One is safe only when he is liked; one is liked only when he is good; one is good only when he controls his thoughts and actions. The neurotic patient feels that if he is uncontrolled (such as by losing conscious direction of himself, by fainting, by losing his mind, by being dependent upon others, etc.) others will not like him, and this is equated to anxiousness. Similarly, if he directly finds himself not liked (such as being unable to please others, finding that others do not agree with him, that others find fault with him, etc.), he is afraid; and he must find some defense, such as a physical symptom excusing his failure to please, a hostile reaction designed to destroy the one who does not like him, a method of withdrawing from others so that they cannot criticize or hurt him, etc.

The treatment method produces a state in which the patient is completely unable to control his thoughts or his actions, and must depend upon the doctors and nurses, and yet in spite of being uncontrolled (and thus "bad"), he finds, in a few days, that he has survived. He may, therefore, without verbalization of these concepts, merely from the experience itself, the living-through, learn to appreciate the fallacy in each one of the three neurotic attitudes I described. It is not being bad to be uncontrolled; even though some of the behavior and ideas are bad in the sense of being inappropriate and incorrect, they nevertheless do not lead to dislike by the doctors and nurses; and security and safety are not, in the last analysis, dependent upon the good will of others —he has been saved from the delirium, not by the magical efforts of the doctor who liked him because he was good, but spontaneously, independently of the doctor. I think these are exactly the same truths which the patient may learn to feel through the verbalization and the interpersonal relationship of psychotherapy: that the doctor does not consider it bad to be uncontrolled in thoughts and to some extent in action; that he may disapprove of or disagree with an idea or action without disliking the patient as a total person; and that, finally and eventually, when the therapy nears an end, the patient can feel safe even without the therapist's affection and protection.

Summary

1. Experience is reported in the treatment of 324 cases by prolonged narcosis from Sodium Amytal, followed by delirium as a result of abrupt discontinuance of the drug. Although the psychoneurotic patients were, on the whole, persons who had been seriously disabled for a long time, and had not responded to psychotherapy, from 57 to 60 per cent (of 205) gained significant improvement.

2. Since only 40 (34 per cent) cases gained improvement out of 119 treated for conditions other than psychoneurosis, the treatment is not now recommended unless there is a significant psychoneurotic component in the patient's illness.

3. Six patients (of 343 begun on treatment, i.e., 1.5 per cent) died, but from what we have learned we are sure this figure can be reduced. Moderately severe complications occurred in 9 per cent of cases, but teamwork and experience with the method can also reduce that figure.

4. Several theories are examined as to the mode of action of the therapy; and the one which appeals to me is that the amytal-delirium treatment provides a psychological setting in which some basic neurotic fears can be faced and lived through, even without verbalization.

5. Many patients after Sodium Amytal therapy are more accessible to psychotherapy; and the improvement rate can probably be definitely increased by properly timed insight psychotherapy.

Author's Note: Sodium Amytal used in this study was supplied by Eli Lilly and Company, Indianapolis, Ind.

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The Neurotic Symptom of "Dripping Hands"

EDMUND BERGLER, M.D.
New York, N. Y.

Every psychiatrist is familiar with the frequent complaint of fear-ridden neurotics: "My hands are always wet." The symptom is banal; typically it is subsumed under the psychosomatic expressions of fear. Here the matter rests; as far as I know, the literature has not dealt with any specific determinants of the psychic superstructure of this specific symptom.

Another characteristic of this symptom is its tenacity; the "dripping hands" are faithfully retained even when all other fear symptoms have subsided in the course of treatment. One should add that the feeling of "dripping hands," though objectively not too disturbing, is subjectively highly overvalued by all patients in its negative and disagreeable results.

I believe that in one particular case I have found a specific psychic reason for the symptom. To my surprise, the symptom subsided quickly after working through. Encouraged by the unexpected outcome, I tried the identical approach with a series of other cases. The results were favorable. This short communication has the purpose of asking colleagues to check with their cases.

The patient, a successful engineer of 35, came into treatment because of erective impotence. Very soon it became apparent that his main trouble was deposited elsewhere: in severe psychic masochistic personality distortion plus severe psychosomatic "intestinal" disturbances in the form of medically inexplicable "cramps." The latter revealed themselves as unconscious dramatizations of the fantasy, "bad mother poisons me." The patient's whole psychic life centered around his mother; under the disguise of martyrdom, she has been holding the now grown man under complete dominance. He has "retaliated" by falling for every one of her tricks, at the same time consciously defending himself with the plea that "he did not even talk to mother." The same attitude was repeated in his relationships with women. Both maritally and extra-maritally, he attached himself to a series of "bitches" whom he at first mistook for "sweet girls." He was completely impotent with all these women. Finally, after rather protracted analysis, he regained his potency with a "sweet-aggressive" girl. This was more than he could stand. He immediately left her and resumed his search. After the divorce (in this marriage he had been fully potent), he returned to the girl who had "taught him sex" and married her. Very soon the same game started again—his neurosis was dying hard. Eventually he came to understand his projections; his intestinal troubles disappeared and he achieved some kind of stabilization, with potency retained.

At the high point of his new-old marital conflict, when the patient "discovered" that his latest wife was a "bitch," too (of course he did his best to overlook the fact that he had married her for that very reason), he had the following dream:

"A man kills two women with a knife. His hands are dripping with blood. I have no idea who the man is, nor why he killed those two shadowy women."

Associations led immediately to mother

and wife; the unknown man, of course, was the patient himself. The dream seemed to represent the patient's hatred of his wife and mother.

Two "details" contradicted this interpretation, which had been supplied by the patient himself. First, his entire relationship with each woman was fully masochistic. Hence it was more likely that the dream expressed the man's *inner defenses and not his inner wishes.* The dream seemed to have a preamble, conveniently left in clair obscure: his inner conscience's accusation of masochistic submission to both women. The dreamer defends himself against this reproach with the strongest pseudo-aggressive weapon possible—murder.

The fact that dreams are not simply fulfillments of repressed wishes symbolically expressed but also (and even predominantly) inner defenses against reproaches of the superego was stressed by Jekels and the present writer twenty years ago. The whole topic is elaborated once more in this author's recent book.[1]

The second detail which contradicts the patient's own interpretation of his dream is this: the murder is committed with a knife. The sexual symbolic connotation was known to the patient; all his conscious self-reproaches had as their theme his "cruelty" to his wife, whom he "tortured by mental cruelty." The physical cruelty consisted of frequetly refusing sex, or sometimes of being incapable of it. In short, he lived out his pseudo-aggression via his sexual "weapon." He frequently "forgot" that his pseudo-aggression was but a defense against his more deeply repressed, though very effective, psychic masochistic wish to be refused.

Obviously, conscious and unconcious are not indentical. How, then, could the patient's conscious and unconscious "fury" coincide? I asked the patient this question, and also reminded him that during the preceding weeks he had told me that he sometimes felt that "killing off all his female tormenters" would be "a way out."

After establishing the masochistic basis, and the pseudo-aggresive defense included in the dream (the latter goes so far that the dreamer admits to Oedipal equation of mother and wife, and veiled sexual wishes involving the mother), only one detail remained obscure. Why the dripping hands? Dripping with blood?

Here it occurred to me that the patient had echoed his habitual complaint in describing his dream. He always spoke of his "dripping hands" when referring to sweat; in his outline of the manifest dream contents he spoke of "hands dripping with blood." The symptom of dripping hands, therefore, could perhaps symbolize his inner defense: "Who is masochistic? I could murder my torturers with my hands!" The hands dripping with blood become hands dripping with sweat.

The interpretation was applied in a series of other cases, and "filled the bill." One specific common denominator was found in all these cases: the patient was an exceedingly masochistic person in desperate need of a pseudo-aggressive alibi.

Finally, the suggested interpretation explains both why "dripping hands" are a symptom of fear, and why the tenacity of the symptom (if not specifically analyzed as suggested above) is so marked. In my experience, internal, neurotic fear pertains exclusively to psychic masochism, secondarily shifted to pseudo-aggression, for which the blame is accepted as "lesser crime," and in a third step shifted outside to transform oneself into the innocent victim. Hence the sufferer from fear appears to be afraid of his own inner aggression (see patient quoted above).

The last problem—the amazing tenacity of the symptom of "dripping hands"—can also be explained. The psychic masochist must have the unconsciously self-provoked proverbial "kick in the jaw," but this is not his only requirement. He needs, and just as badly, his pseudo-aggressive alibi. And are not "hands dripping with blood" a first-class inner alibi?

1. "The Superego," *Grune & Stratton*. New York, 1952.

Diagnosis, Pathogenesis and Treatment of Mental Disorders

SOLOMON KATZENELBOGEN, M.D.
Washington, D.C.

The term "pathogenesis" in the title stands for "psychodynamics," which, however, has a broader meaning. Psychodynamics is concerned with the mental processes underlying both normal and abnormal personality functioning. When applied specifically to abnormal personality functioning—to mental diseases—"psychodynamics" as used in psychiatry is the counterpart of "pathogenesis" as used in medicine.

What prompts me to discuss this subject is my experience at our Clinical Psychiatric Conferences at Saint Elizabeths Hospital—experience suggesting that there are wide differences in the understanding of the meaning and scope of the terms diagnosis and psychodynamics. The issue appears to be fundamental enough for both psychiatric studies of patients and their treatment to call for attempts at clarification. Two case histories will be used in this presentation; they were selected, not because they appear complicated in regard to diagnosis or psychodynamics, but because they offer adequate illustrative material.

The first case history is that of a man forty-eight years old. When I first saw him he talked of his essential troubles as follows:

"My head feels like there is an iron band around it. I want to scream. What bothers me is that I cannot remember things. I am afraid to look at the newspapers. I started to figure out the laws of nature; I tried to figure out how an auto runs; how a chicken comes out; how this and that happens. Sometimes I think I am going out of my mind. That terrible force in me is trying to go into the knowledge of how a child is born; how the seed of the man meets the seed of the mother. I feel depressed all the time. I try to figure out things and cannot and then I get depressed. I feel I am going to explode. I feel my imagination runs away with me. After being with people, I try to remember their faces and their names and feel terrible."

In answering questions, he stated that his depression depends on what he is trying to figure out; that when he comes to a solution of a problem he feels relieved and the depression clears up. My impression was that the patient was suffering from both depression and obsessive reactions; that the depression was, in a large measure, if not essentially, a reaction to those obsessions.

The history of his illness revealed admissions to various hospitals resulting in different diagnoses. The onset of his trouble seemed to be about nine months back when he learned that his oldest son was killed in action. Five months following this he received twelve electric shock treatments. According to the patient's wife, his obsessions, restlessness and agitation, particularly the obsessions, became worse. The psychiatrist advised more shock treatments. The advice was not accepted and he was hospitalized for about two months. The diagnosis was obsessive compulsive neurosis. After having been home for nearly three months he was placed in another mental hospital where the diagnosis was: manic-depressive, depression. However, the description of his condition contains the following statement: "One typical obsessional behavior occurred when he was curious as to where two Washington streets crossed; and one morning he was found walking down one of the streets until he reached the point where the other one crossed." After a two month's stay in this hospital he went home. Because the agitation, depression and the obsessional behavior continued for the next four months, further hospitalization was necessary.

He was then admitted to Saint Elizabeths Hospital where he described his difficulties as follows: "I want to remember things and can't. I think I hold too much on my mind. I can't seem to concentrate and am unable to keep an idea in mind for any length of time. It's just a mess . . . it is a compulsion to want to know, and I can't know it all . . . faces of people remind me of somebody I thought I knew, but I can't think who it is, and that makes me worried." He stated that he felt depressed, was afraid of going insane because, as the examining psychiatrist ex-

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pressed it, "of the unending kaleidoscope of ideas which continually drum at him." He was diagnosed as manic depressive psychosis, depressive type. He was given sub-shock insulin therapy for 6 weeks, without improvement. After further studies the psychiatrist summarized his impression as follows: "The present depression is in some way related to the death of the oldest son in France. The facts are, however, that the patient has long since been an obsessive-compulsive personality, prone to depression at frequent intervals. . . . In view of his continued complaint of "figures running through my mind—I have to keep figuring all the time, etc." it is felt that the depression continues to be on an obsessive-compulsive basis in a decompensated personality." After five months of hospitalization the patient went home on indefinite visit as improved and later was discharged.

For the purpose of this discussion, my main interest is not in the diagnostic label which would place this patient into an appropriate diagnostic classification. The point I do want to emphasize is, that for the sake of adequate therapeutic handling of the patient, it is not the categorical diagnosis which is all important; of much more significance is the full recognition of the troubles from which the patient suffers.

In a broader sense, a diagnosis, therefore, is a factual description of the patient's actual difficulties elicited by the examiner. For an adequate understanding of the meaning of those difficulties, it is necessary to study their origin and development, their relationships, the environmental circumstances in which they occurred, the long-range preillness personality function of the patient under various life experiences. Such a comprehensive study may not be necessary in some cases for the classification diagnosis; in other cases, such a study will contribute greatly to the elimination of diagnostic errors. However, for therapeutic purposes such a broadening of the meaning of diagnosis is eminently necessary.

In further evaluating this case history, my first diagnostic impression is confirmed, namely, that the patient's complaints, as reported verbatim, indicate the combination of both depressive and psychoneurotic reactions. The psychiatrists called upon to diagnose the condition, in their understandable aim to reach a uniform diagnosis, have focused their attention more specifically either on the depressive or the obsessive reactions. Yet, from the patient's description of his troubles one cannot help being impressed by the prominence of both, the depressive reactions and the obsessive ruminations. The relationship, particularly in the sequency of the two types of reactions, is striking: the depression following the obsessions both in appearance and in clearing up. Whether the obsessions or the depressive reactions are primary in their origin may be debatable, but the obvious fact is, that both are prominent. One is therefore closer to a factual description of the patient's troubles in regarding his condition as a combination of depression and obsessive reactions. Such a formulation leading to a hybrid diagnosis—depression and psychoneurosis—might have been troublesome for the psychiatrist expected to subordinate his diagnostic evaluation to the requirements for classification of mental disorders. But, therapeutically, the hybrid diagnosis of depression and psychoneurosis certainly would have led to more understanding treatment. For, in this era of specialization, when shock treatment is regarded by some as the specific treatment of depression—assuming that they are correct—it is of the utmost importance to recognize significant psychoneurotic conditions, when, to my knowledge and understanding, shock treatment is definitely contraindicated.

The second case history more forcefully than the first illustrates the fact that a diagnostic evaluation of a clinical picture requires appraisal of the meaning of different symptoms in certain constellations. The case also provides more specific material for the discussion of psychodynamics.

This patient was a colored woman, thirty years old, admitted to Saint Elizabeths Hospital on January 16, 1947. The admission note contains the following essential points: The patient was alert, in good contact, well oriented in all spheres, friendly; she answered questions without hesitation, relevantly and coherently. She complained of worries in connection with her separation

from her husband and two children; the examiner felt that the separation was warranted. Her mood was appropriate and in harmony with what she said. There was no impairment of memory, except for certain events during her acute illness. She did remember having heard the voice of her husband threatening to kill her.

The beginning of her present illness was traced back to November 28th, 1947 and was described by her mother and sister, with whom she lived, as follows: "She became sullen and confused; the confusion lasted from 4 to 5 days. She talked of worrying about what her husband had said—that he was going to frame her and do things to her; that her fingerprints were on his house; that he would use those fingerprints against her. When the door bell would ring, she would say 'don't open it—don't let him in, he is going to kill me.' " She began to have what the informants called "hysterical attacks" when she would scream at the top of her lungs—always expressing fear of her husband. The patient, herself, stated that she had been hearing the voice of her husband threatening to kill her. She was taken to Gallinger Hospital on December 19th, 1946, and a month later transferred to Saint Elizabeths Hospital.

As a girl the patient had always been a good student and after graduating from high school she attended teacher's college for one year. In addition, she had a good musical education. At the age of twenty-one she married a man fifteen years her senior, who drove a cab, operated a grocery store and posed as a minister. She had expected to work with him, playing the piano for his church services; but soon after her marriage, she learned that her husband was not a preacher. Their married life turned out to be very unhappy. Her husband failed to provide for her or for the home; he did not pay the rent, and they were forced to move frequently. He often threatened to kill her, always denouncing and reprimanding her. Since her marriage she had had no recreation. The husband would not allow her to have a key to the house, so that she had to stay home. She suffered so that she finally left her husband and returned to her parents. Yielding to his persuasion she went back to live with her husband. After the birth of the second child she felt that she should try to remain with him for the sake of her children. Family life became worse and worse. Whenever the patient took a job to help out financially, her husband told the children that their mother did not care for them; that if she had cared for them she would not leave them to go to work. He encouraged the children to disobey her and would cross-examine them concerning their mother's doings in the home so that he could reprimand her. When the patient was not working he would padlock the door on the outside so that neither the children nor the mother could go out. He constantly criticized the way she dressed the children, the way she prepared the meals, her table manners, etc. These criticisms were always made in the presence of the children. He accused her of infidelity without any reason. He refused to let her visit a doctor when she was pregnant and when she was ill in bed he completely neglected her for two days. On May 28th, 1946, while pregnant with the third child, she again returned to her parents' home, leaving the two children with her husband, because he had threatened to kill her if she attempted to take them. This time she filed suit for divorce.

After the birth of the third child she returned to work her hours being from 5 P.M. to 1 A.M. so that she could take care of the baby during the day and put it to bed before going to work. A few days before her breakdown while returning from work, she was followed by a man for some distance. This alarmed her, but the man disappeared, then her husband arrived and accused her of running around at night and carousing. He threatened to go to court and take the baby from her on the grounds that she was not a fit mother. On the day before her breakdown she visited the children as usual and found them dirty and the apartment in very bad condition.

At a diagnostic conference some of those present, impressed by the patient's auditory hallucinations—hearing the voice of her husband threatening to kill her—suggested a diagnosis of schizophrenia. However, considering the terrible strain under which the

patient had been living for years and the immediate events which precipitated her acute condition, her schizophrenic reactions appeared understandable against the background of an essentially psychoneurotic condition, namely, anxiety state.

Psychodynamics, as previously defined, is concerned with the mental processes underlying personality functioning: One speaks of *psychic determinism,* implying that certain personality reaction and symptoms of mental disorders are outward manifestations of mental processes of which the individual is either completely unaware or only slightly aware. That the unconscious plays an important part in the formation of certain symptoms of mental diseases is generally admitted. For some, however, the unconscious is the all powerful force responsible for certain every-day life reactions of the average normal individual and for abnormal reactions in mental disorders.

My own belief is that overemphasis of the role of the unconscious often results in the unwarranted failure to fully recognize the potency of the *reasoning person versus the feeling person in the eternal struggle between the pleasure principle and the reality principle.*

Another contention which, to my mind, also suffers from exaggerating the significance of a basically sound principle is that experiences in early childhood are essentially, if not exclusively, the determining factor for the adult personality function. It is generally recognized that early childhood is singularly receptive to influences from the immediate environment for, at least, two obvious reasons: entire dependence of the child upon that environment for the gratification of his biological needs, and his inability to meet critically environmental influences, because of lack of previous experiences. It seems to me, however, that this overemphasis of the psychodynamic effects of early childhood experiences obscures recognition of the importance of other equally valid factors. My understanding is that environmental influences begin as early as the intrauterine life; that they affect the progeny very significantly in early childhood, but that they continue to remain effective throughout the life of the individual; that in all periods of life there is consistent interaction between personality and environment.

To apply these factors to our second patient, we consider that the painful experiences to which she had been subjected during the years of her married life and their cumulative effects are just as potent psychodynamic elements as her early childhood experiences. Thus, the meaning of psychodynamics is broadened in that it includes the mental processes caused not only by early childhood experiences but equally by experiences throughout the life of the patient, up to the illness. To be more specific, life experiences at any age may be valid psychodynamic factors as such, regardless of whether they may be reasonably connected with certain early childhood experiences. Such an understanding of psychodynamics contributes to diagnostic evaluation of the patient's troubles and their treatment.

The guiding principle of rational or genetic-dynamic psychotherapy is the recognition that the patient's present-day reactions are somehow connected with past life experiences. In adopting our meaning of psychodynamics, the psychotherapist will consider as significant material for psychotherapeutic discussions any and all emotional traumas which had occurred not only in early childhood, but also at any time throughout the life of the individual. His method of treatment, therefore, will depend upon the analysis of the patient's personality function in the present and throughout his past life.

In these general remarks there is little room for mention of the content of psychotherapeutic discussions; it is self-evident that the content is as varied and polymorphous as human experiences, ideas, fleeting or more consistent thoughts, day or night dreams can be. I want to stress that the concept of the meaning of genetic-dynamic psychotherapy advocated here—the counterpart of etiologic pathogenetic therapy in medicine—leads to recognition of the etiologic and psychodynamic significance, not only of emotional traumas, conscious and unconscious ones, but also of other factors. I should like to discuss two such outstanding factors which can and should be used for therapeutic purposes. One factor, within the patient, is

habit formation. I shall try to illustrate the application of the therapeutic principle based on the concept of habit formation in a group of patients suffering from difficulties commonly encountered:

Mrs. R., forty years old, feared being left alone in her apartment, though located in a large building and, of course, surrounded by neighbors. When her husband went to work she visited with neighbors until his return. She was afraid to walk alone on a street which appeared to her "deserted," meaning that there were few people about. She would not let her husband drive through roads where there was little traffic and few pedestrians.

Mrs. B., 46 years old, would not go down town or enter any department store, unless accompanied by her husband or sister. She was afraid to attend Sunday church services, even if accompanied by her husband. Being a devout Catholic, this was to her "a great sorrow."

Mr. T., in his late thirties, was extremely self-conscious when conversing with people in business and socially. He was not able to look at somebody without becoming "extremely nervous." He was particularly afraid to visit a barber-shop when other customers were there; he could not bear people looking at him. He would go to the barber a few minutes before closing when there were no other customers waiting.

A man, thirty-five years old (O.A.) a lawyer, would be overwhelmed by fear if he read anything dealing with or even remotely referring to abnormal mental reactions. He could not make himself read such material and would leave a theater if any reference were made to insanity.

In all these cases two factors are at work. One is the basic genetic-dynamic content, conscious and unconscious emotional disturbances. These may be adequately handled by psychotherapeutic comprehensive personality studies. The other psychodynamic factor is that of habituation. By reason of their essential difficulties, the patients had developed patterns of behavior to which they became the more habituated, since those behavior patterns protected them against their fears and anxieties. However, those habits had, at the same time, contributed to the maintenance of modes of living which gradually had become integrated into their personality function. Thus, both, genetic-dynamic factors and habit work together, the former more potently, to perpetuate abnormal behavior. Therefore, as soon as the psychotherapist, following a certain period of psychotherapeutic sessions, varied for different patients, believes that the patient's fear, his inability to do certain things or compulsion to do others are somewhat alleviated, he encourages the patient to try to do what he has been avoiding, or to abstain from his compulsions. At the start the patient is encouraged to make these attempts moderately, to the extent that he will not feel too uncomfortable. The patient is cautioned not to force himself, nor to expect improvement rapidly. The basic concepts underlying the procedure of dehabituation is explained to the patient; the essence of the procedure is summed up in a statement: "Do what you can, with least discomfort, but do it consistently, make of it a daily task." Thus, to reiterate, genetic-dynamic treatment, in the psychotherapeutic sessions, should be paralleled by encouraging the patient to do active, practical self-reeducation, from the time that he is prepared for it. The experienced psychotherapist can estimate the patients state of preparedness fairly accurately. Mere waiting for completion of the treatment, expecting that the difficulties will then vanish, is unwarranted passivity. It allows the patient to maintain his difficulties without attempting to provoke some break in his abnormal behavior even though a very modest one.

The other factor lies in the patient's present environment; its positive or negative psychotherapeutic influences cannot be too strongly emphasized. Granted that the patient, himself, may be wholly, or significantly, the maker of his environment yet, the fact remains that a given environment, in itself, may be helpful or harmful to that individual. To ignore the part of the present-day environment in the patient's difficulties, in the belief that when his internal conflicts will be resolved by the psychotherapeutic sessions he will be able to adjust to the environmental adversities, is not to recognize a significant etiologic factor. Not to be concerned about environment is to deprive psychotherapy of additional support and in some instances even to allow the adverse environment to weaken, and possibly neutralize its accomplishments.

Carbon Dioxide Inhalation Therapy

ALBERT A. LAVERNE, M.D., and MORRIS HERMAN, M.D.

New York, New York

I. History of Development of Carbon Dioxide Inhalation Therapy

A. In 1926, Loevenhart, Lorenz, and Waters first introduced carbon dioxide inhalation therapy into psychiatry. They treated catatonic psychotics with prolonged multiple breath inhalation of carbon dioxide (30 to 40 per cent carbon dioxide and oxygen mixtures). The catatonic state resolved for about one-half hour but then immediately reverted to its original condition. Their theory was that a disordered function of brain must be corrected by physiological and biochemical means. The report of this study was published in 1929 but their technique has since been abandoned.

B. In 1943 L. J. Meduna began to use carbon dioxide inhalation therapy on psychoneurotics with the theoretical assumption that psychoneurotic conditions are physical derangements of function of the nerve cells in the brain, and that therefore, they must be receptive and responsive to physical or neurophysiological treatments, without the adjunctive use of psychotherapy. He postulated a physiological theory of psychoneurosis. From 1947 to 1949 he wrote a series of papers dealing with the treatment of psychoneurosis by carbon dioxide inhalation, and in 1950 published a monograph entitled Carbon Dioxide Therapy with a report on 100 treated cases.

II. The Meduna Technique of Carbon Dioxide Inhalation Therapy

L. J. Meduna uses a mixture of 30 per cent carbon dioxide and 70 per cent oxygen administered to the patient in a supine position through a mask and breathing bag. A total of 20 to 50 such consecutive inhalations produces various depths of coma or anesthesia. He describes three stages of anesthesia:

1. Introductory stage: One to 24 respirations.

2. Anesthesia phase: Producing sensory and motor discharges consisting of autonomic changes such as increase of blood pressure, pulse, flushing and mottling of the skin, perspiration, vocalizations, motor discharges evidenced by blinking, fluttering of the eyelids, tonic and clonic movements simulating bicycling movements and quadrupedization, and finally when deep coma is achieved a decerebrate fit ensues consisting of opisthotonus, tonic extension of all extremities, and pupilary areflexia.

3. Transition phase: Return to consciousness and the abreactions.

The patient when conscious may recall a dream consisting of a geometric pattern with or without colors and formed symbols.

Contra-indications: Hypertension, active pulmonary tuberculosis, cardiovascular disease.

Nitrous oxide inhalation is occasionally used in the induction phase in patients who cannot tolerate carbon dioxide directly.

Meduna asserts that psychotherapy is unnecessary in psychoneurotic conditions, and that therefore, even the general practitioner could successfully treat these illnesss with carbon dioxide inhalation therapy.

III. Mechanism of Action and Rationale of Carbon Dioxide Inhalation Therapy

A. Physiological Theories

1. According to Lorente DeNo, carbon dioxide produces the following changes in the nerve cell of the CNS:

a. Increase in membrane potential.
b. Increase in threshold of stimulation.
c. Increased ability to release energy.
d. Decrease of fatigability.

2. Gibbs, Williams and Gibbs, using 30 per

This is a preliminary report of 25 patients treated with the Meduna Technique of Carbon Dioxide Inhalation Therapy (30 per cent carbon dioxide and 70 per cent oxygen mixture). This research project was conducted at the Bellevue Psychiatric Hospital, New York, under the auspices of the New York University-Bellevue Medical Centre.

Read at the Symposium on Research and Treatment in CO-2 Therapy, May 12, 1952 at Atlantic City, N. J.

cent carbon dioxide and 70 per cent oxygen mixture showed that there is electrical activity measurable on the electroencephalograph consisting of slow 3 to 4 per second high voltage activity appearing at about the 18th respiration. After 25 seconds the former activity begins to return.

3. Reverberating Circuit Theory of Meduna—carbon dioxide increases the threshold of stimulation of every nerve cell in direct proportion to the logarithm of the concentration of the carbon dioxide inside and outside the cell membrane. Carbon dioxide thus removes the stimulus which has set the reverberating circuit into action, that is the feed-back mechanisms, and thus restores homeostasis.

4. Schmidt, C. F. suggests that carbon dioxide has a specific vasodilator effect on cerebral blood vessels. Of a large variety of agents which have been found capable of dilating cerebral vessels, carbon dioxide inhalation produced the maximal intracranial vasodilation.

5. At the Carbon Dioxide Symposium held at the American Psychiatric Association meeting May 12, 1952, evidence was presented on unpublished work done by Shaffer of the United States Public Health Service that animals continuously exposed to three to seven percent concentration of carbon dioxide in room air for varying periods of time demonstrated stimulation of the pituitary and adrenal glands consisting of hypertrophy of beta cells of the anterior pituitary, hypertrophy of cells of the adrenal cortex and medulla, involutional atrophy of the thyroid cells. When the animals were placed in room atmosphere, all the observed changes reversed to normal.

6. Several physicians from Canada and the United States commented at this Symposium that they had personally observed that some patients with an associated rheumatoid arthritis treated with carbon dioxide inhalation therapy for neurotic symptoms manifested an alleviation, and in some cases a remission of their rheumatoid symptoms.

B. Psychological Theories

1. Paul Wilcox has demonstrated that carbon dioxide is a specific agent for subconscious release.

VI. Results in 100 Treated Cases

Meduna has stated that carbon dioxide inhalation therapy with his technique (without psychotherapy) has no value in the psychoses, obsessive-compulsive neuroses, psychopathic states, psychomotor epilepsy.

Of 100 treated patients 68 per cent improved. Improvement was considered to have taken place when the overt symptoms of which the patient complained, disappeared at the termination of treatment, up to a four year follow-up. These treated cases included psychosomatic conditions, anxiety states, conversion hysterias, neurotic alcoholics, passive neurotic homosexuals.

Five of the 68 improved patients relapsed (about 7 per cent).

Meduna classifies his groups into reactions as follows:

1. Sympathetic reactions: the anxiety cases.

2. Parasympathetic reactions: psychosomatic cases such as spastic colitis, ulcerative colitis, and cardiospasm, frigidity, impotence.

3. Ideo-motor reactions: character neuroses, inferiority neuroses, homosexuals.

4. Motor reactions: conversion hysterias such as tics, stutterers.

Meduna concedes that variables may influence results to a certain extent such as:

1. Autosuggestion.

2. Mass suggestion of patients congregating in the waiting room.

3. The patient spontaneously writing long emotional letters to the therapist.

There is no application of direct supportive or other formal psychotherapy.

The number of carbon dioxide treatments varied from 20 to 100, administered three treatments per week. It has been found that if the patient shows no clinical improvement in 15 treatments then the case is considered to be a failure.

V. Results Using the Meduna Technique

One member of our research group visited Meduna in Chicago and studied his technique before initiating the project at this institution.

A. *Method*—Patients (unselected in- and out-patients) were given initial psychiatric and psychological examinations.

A pre-treatment clinical evaluation was made as follows:

1. Subjective evaluation of affect.
2. Objective signs of tension and anxiety.
3. Object evidence of adjustment to conflict or the external experience of the conflict (marital, occupational, social, educational, etc.)
4. Somatic disturbances.
5. Sleep.
6. Appetite, gastro-intestinal, weight.
7. Medication.
8. Remarks.

This clinical data was evaluated from information obtained from the patient and his family. Treatments were administered three times per week up to 100 treatments. Autonomic reactions, motor discharges and abreactions were noted at each treatment. Clinical evaluations were made at intervals during the course of treatment, and at the termination of the series. Psychological re-evaluations were made on some patients after termination of treatment. All patients who completed treatment received up to nine months follow-up.

B. *Results*

Of 20 patients representing types of cases recommended for carbon dioxide therapy, four (20 per cent) improved. Six of this group of 20 patients received concurrent psychotherapy with carbon dioxide inhalation therapy. The breakdown of the 20 treated is as follows:

1. Anxiety psychoneuroses 8; two improved.

2. Hysteria conversion, and psychosomatic syndromes 4; one improved 20 per cent (blepharospasm).

3. Alcoholic neurotics 6; one improved.

4. Stammerer 1; no improvement.

5. Homosexual neurotic 1; no improvement.

C. The breakdown of five treated cases that Meduna does not recommend for carbon dioxide therapy is as follows:

1. Obsessive-compulsive neuroses 3; no improvement.

2. Schizophrenic psychoses (mixed variety) 2; no improvement.

D. *Supplemental Therapy Combined with Carbon Dioxide Inhalation Therapy.*

Of all the patients in the research series 70 per cent have had previous psychiatric treatment unsuccessfully.

2. In this series 40 per cent received psychotherapy concurrently with carbon dioxide therapy.

3. There appeared to be no significant influence on the overall results whether the patient had previous or concurrent psychotherapy in relation to the carbon dioxide therapy.

VI. Remarks and Observations

A. Transference of the patient to the therapist is rapidly and intensely achieved with carbon dioxide inhalation therapy unless it is complicated by the development of treatment anxiety.

B. A physiological immediate effect of carbon dioxide coma therapy is a lessening of anxiety upon awakening and lasting from one to several hours. This has been demonstrated on a few cases by psychological visual-motor performance tests. However, this is only a transient alleviation of anxiety.

C. Anxiety associated with carbon dioxide inhalation therapy can be classified dynamically as follows:

1. Fear of suffocation.
   a. Psychological.
   b. Physiological: Carbon dioxide air hunger.
2. Fear of death motivated by conflictual guilt.
3. Carbon dioxide neurosis or anxiety associated with treatment which may develop from the tenth to twentieth treatment.
4. Combinations of the above.

The anxiety which is engendered during carbon dioxide therapy may frighten the patient or may produce an exacerbation of the clinical symptoms with a superimposed anxiety. In one patient the anxiety developed into a panic state bordering on acute psychosis. This complication, which is by no means infrequent, requires all the skill of the therapist in management, is extremely difficult to diminish or desensitize, and represents a genuine hazard in the administration of therapy to neurotics.

Meduna attributes this complication in anxiety neurotics to overtreatment. Our series demonstrates that it does occur in other types of neurotics besides the anxiety state, though to a lesser extent. Furthermore, we have not been able to entirely prevent this complication by avoiding overtreatment, namely, by reducing frequency and intensity of administration, and by the use of nitrous oxide induction anesthesia.

D. Physical Complications of Carbon Dioxide Therapy—One alcoholic developed during the course of carbon dioxide therapy (fifteen treatments) severe bi-lateral subconjunctival hemorrhages requiring cessation of therapy. This complication resolved without residual after two weeks.

E. Variables Extraneous—There is a factor of mass and autosuggestion which is introduced into the evaluation of carbon dioxide therapy and consists of patient to patient transference in which they relate their individual experiences during treatments and these patients have actually formed a Carbon Dioxide Club which has social as well as supportive implications.

VII. Conclusions

A. Carbon Dioxide Inhalation Therapy is not without psychiatric hazards if precautions in selection of patients and administration of therapy are not carefully observed.

B. Carbon Dioxide Inhalation Therapy appears to be a relatively safe procedure as regards physical complications provided the contraindications are observed.

C. It is recommended that Carbon Dioxide Inhalation Therapy be administered only by physicians with adequate experience in the psychiatric discipline.

D. The results of the efficacy of Carbon Dioxide Inhalation Therapy as a therapeutic agent in the treatment of neuroses have thus far been insignificant. However, the series is too small for adequate evaluation.

E. We are continuing to enlarge the series on neurosis utilizing Meduna's Technique with the incorporation of adequate control studies.

A Cinematographic Analysis of Reactions Under CO-2 Treatment

L. DOUGLAS MACRAE, M.D.
Bay City, Michigan

When patients are treated with a suitable mixture of CO_2 and O_2 a variety of reactions, subjective and objective, are produced. These reactions indicate the condition of stress produced by the actual treatment, or in many cases, these reactions are conditioned by previous experiences and by the present pathological condition of the patient.

The reactions are subjective and objective. The subjective reactions occur during the introductory phase of the CO_2 treatment. This phase begins at the first respiration and terminates gradually as the patient loses consciousness. These subjective reactions described by the patients can be classified into four different groups:

1. Smothering Sensation: This smothering sensation varies from a slight feeling of anxiety to a terrific panic, reaching its peak at the seventh or eighth respiration. This sensation is usually preconditioned in the patient by fear due to having been smothered by ether anesthesia, a previous drowning experience, having been choked, having been inadvertently covered by blankets, or other similar experiences.

2. Burning Sensation: This feeling varies from a feeling of excessive warmth to burning up and develops usually between the ninth to fourteenth respirations. The burning sensation is not as frequent as the smothering sensation and I have found it in only about 30 per cent of my cases. Through meticulous questioning of these patients I have found that the burning sensation develops in patients who have been overheated, had high fevers, or experienced fire or explosion.

3. Death Sensation: This sensation is most common between the fourteenth and twentieth respirations. The feeling is usually accompanied by dizziness trembling, and blacking out. The death sensation is usually produced by immature sex feelings that become attached to the idea of death. It is also caused by having seen someone else crippled.

4. Oblivion Sensation: This sensation is the most severe at the beginning of the anesthesia phase when the patient is in the process of losing consciousness.

The objective reactions of the patients we can ascertain by observing the patients, or better, by analyzing a large number of moving pictures. On the whole, the objective reactions can be classified into three groups: a) the psychomotor reactions; b) the autonomic nervous system reactions; c) the general neurological reactions. Both the general neurological reactions and the autonomic nervous system reactions have been described by Meduna in his monograph. I omit them, therefore, from this discussion.

One or two, or even more patterns of the psychomotor reactions may occur simultaneously, but relatively pure samples have occurred often enough to make the differentiation possible and to be demonstrable in moving pictures.

The six psychomotor patterns are:

1. Attention
2. Lonesomeness
3. Suffering
4. Rage
5. Fear
6. Delirium

1. The psychomotor pattern I have called *Attention* consists either of getting or giving attention. This function is represented during the CO_2 treatment mostly in the form of dreams. The patient's dreams during the treatment become important when they are so intense that they affect the feelings of the patient the following day; when they tend to repeat; or when they are symbolic to the extent that the patient is unable to correlate the dreams with his own feelings, ideas, and memories. Talking over these dreams with the patient tends to remove the dream or change it to a more normal type. Giving several treatments about five minutes apart during the same visit, brings out the CO_2 dreams best. It is an interesting observation that the CO_2 treatments change the patient's night dreams so they become normal.

2. *Lonesomeness* is indicated by the patient crying as with a broken heart during the transitional phase, coming out of treatment. The crying is more of anguish than of suffering and is based on some rejection either by parents early in life or by being neglected by brothers and sisters. Difficulty in emotional weaning from mother and father may produce the feeling of lonesomeness also. Later in life, this feeling would arise again accentuated by some severe loss. Sometimes only a tear is evidence of this pattern, at other times the patients may cry for minutes. Giving the patient sympathy during this reaction enhances it and the patient may cry with large and copious tears. At times the lonesomeness reaction is associated with depression. Both respond fairly well to CO_2 treatment.

3. The reaction I call *Suffering* is shown by groaning and moaning of the patient. These sounds are similar to the sounds the patient makes when really suffering. These patients are not recalling suffering they had in life, but seem to express or imitate the suffering of a loved one. Their helplessness to relieve the loved one was so great that the engrammes of their inadequacy reappear during the treatment. These patients usually suffer from conversion symptoms accompanied by anxiety. It is interesting to note that these patients often put their hands over the organ afflicted. This would be the same organ which caused the suffering or death of the loved one. These patients take treatment well and tend to be relieved from depression with CO_2 treatments. The psychomotor reaction of suffering is of two types; one which is felt in the relatively untreated individual and the other which is recognized by a tone of insincerity. This insincere suffering reaction I have found in those patients who had been doctoring for their neuroses so long that the illness lost much of its original tone and was only a means of getting drugs.

4. The *Rage* reaction is shown by rigid, flexed elbows, clenched fists, and sometimes arched back. During these expressive psychomotor reactions, the patients sputter, spit, and make sounds which impress one as

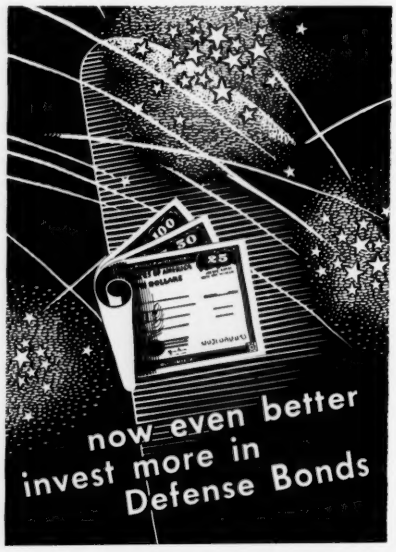
argumentative. The rage reaction, if expressed by the arched back, is apparently of symbolic type. This is the reaction of the meek soul who calls on God to do his killing for him, just as the small child looks to his father demanding that the father do what the child wants done. This reaction may be caused by a situation arising in later years which accentuates an early childhood experience in which the patient was unable to talk back or do anything about the situation and is therefore suffering a repressed hostility.

5. *Fear.* Fear reaction manifests itself in five different ways: a) by changes in the depth and rate of respiration. This reaction is caused by a fear of suffocation prevalent in asthma patients; b) by bizarre movements or positions of the extremities and mouth which imitate the patient's position or movements associated with the unconscious memory of the fear; c) by special words and sounds associated with fright that the patient had suffered earlier in life; d) by special sex movements denoting fear associated with sex practices; e) by panic usually represented by wild yelling and many muscular movements associated with escape. This panic usually appears after the patient has scared himself by reading ghost stories or having been told similar stories by his parents. This I call *Phantasy Fear.* If one can talk over a more terrible situation than the one the patient has had or imagined, it will help him to undergo the terrors he has of the treatment and will decrease the intensity of the reaction to the treatment.

6. *Delirium.* In this reaction the patient is disoriented as to place and time. He attempts to get up and out of the room in deep bewilderment and is desperately trying to get back to reality. The movements of delirium are voluntary. The patient's experience is that of unreality. Patients who manifest delirium reaction to the CO_2 therapy tend to terminate the treatment because they are desperately afraid of becoming insane. They are not at all sure of the integrity of their personality. These patients seem to do well if E.C.T. precedes the CO_2 treatments or if the two treatments are alternated.

The six psychomotor patterns are easily discerned and they should be the basis of operation if the doctor intends to use psychotherapy of any kind in conjunction with the CO_2 treatment.

It must be kept in mind that the CO_2 therapy and its adjunct—psychotherapy—should have one common goal. This goal is to eradicate the psychomotor reactions so the patient will have only a very mild CO_2 reaction accompanied by normal dreams. If this is achieved and the patient becomes symptom free he can be considered clinically cured.



Neurological Clinical Pathological Conference of the Cincinnati General Hospital

CHARLES D. ARING, M.D., *Editor*

CASE NO. 260029

Presentation

G.S., a 60-year-old negro cook, was first seen in Neurology Clinic on January 26, 1950. He said that while getting out of bed the previous morning he noted his left upper extremity had become numb and he found himself unable to move it. Several days previously he had been aware of a bifrontal headache, there had been no associated nausea or vomiting. In the months preceding the onset of this illness there had been several "falling out" spells diagnosed as "high blood pressure" by a local physician.

Physical examination revealed a well-oriented man who had a blood pressure of 140/100. His handedness was not recorded. There was slurred speech, pupillary inequality, the right was 4 mm., the left 1.5 mm. and somewhat irregular, and both reacted promptly to light and accommodation. There was supranuclear palsy of the left face, deviation of the tongue to the left on protrusion, a snout reflex and weakness of the left upper extremity, the distal musculature being weaker than the proximal. There was an equivocal Babinski response on the left but otherwise the reflexes were described as equal and active. He was placed on nicotinic acid and whiskey and on returning one week later had recovered to such an extent that the only discernible weakness was in the grip of his left hand. A lumbar puncture showed an initial pressure of 140 mm. H_2O and a protein of 53 mg. per cent, the remainder of the csf. examination being normal.

The patient was next seen on September 19, 1950, when he was brought to the receiving ward on the advice of a private physician who reported that he had been having periods of confusion between which there was complete lucidity and coherence. There was also a story of fainting spells during which the patient lost consciousness but no associated convulsive phenomena were observed. The blood pressure was now 165/120 and the physical examination was much as before; both plantar responses were flexor but a Hoffmann sign was present on the left. Weakness of the left face and hand persisted. Cerebrospinal fluid pressure was 170 mm. H_2O and the protein was now 44 mg. per cent. He was again put on nicotinic acid and whiskey and he was requested to return to neurology clinic in two weeks.

The patient failed to keep this appointment and was not seen again until April 19, 1951, when he was brought to the hospital in coma, reportedly having had a series of left-sided seizures that same morning. The examiner noted severe dehydration, pupils which were unequal as previously described but, in addition, were sluggish in their reaction to light, hyperactive deep reflexes, and a Babinski response on the left. There were continuous clonic and tonic movements involving the musculature of the left side. After these had stopped, an electroencephalogram showed suppression of electrical activity in all leads, consistent with a post-convulsive state. A traumatic lumbar puncture showed an initial pressure of 70 mm. H_2O and a protein of 102 mg. per cent, chlorides 750, and sugar 82 mg. per cent. There were 4 lymphocytes and 1782 red blood cells per cmm. in the supernatant fluid. Serological tests on blood and csf. were normal on the several contacts with him. No diagnostic abnormalities were visualized on the skull films. The pineal gland was not calcified.

On April 20 an operation was performed.

Differential Diagnosis

Dr. Harry M. Salzer: I will not bother with the historical details as we have them but will move right on to the problem of localization. One would certainly think that the right sensory and motor cortex—the arm area and possibly sub-cortex—was involved first because of the numb and weak left upper extremity of January 25, 1950. The bifrontal headache of several days' duration was not of localizing value; his spells of "falling out" diagnosed by a local physician as "high blood pressure," too, were of no localizing value. Slurred speech, a sign which could arise from disorder of many areas in the nervous system, is of no localizing value. It could take origin from a cortical, cerebellar, brain stem or muscle lesion. Pupillary inequality may mean midbrain involvement as may pupillary irregularity. The supranuclear palsy of the left side of the face and also the other signs involving the left side suggested a superficial lesion in the right cerebrum, in the face, head and arm areas rather than deeply placed because the leg was not involved and the plantar response was described as equivocal. I do not believe this was a deep lesion involving the pyramidal system.

There was a certain reversibility in this process inasmuch as a week later the only

discernible weakness was in the left grip which would again point to the right cortex, particularly the motor arm and hand area. Then the patient was seen 9 months later with the story of periods of confusion between which there was coherence. Transient involvement of a frontal lobe is indicated but on which side was not clear. There was a Hoffmann sign on the left, again suggesting right cortical involvement in the arm and hand area, and there was weakness of the left side of the face. Apparently this attack cleared because he did not reappear for 7 months.

The patient was seen again in April 1951, fifteen months after the original onset. On this admission he was in coma. Reported as having left-sided seizures, one would again consider the right cerebrum to be involved. The statement about continuous clonic and tonic movement involving the musculature of the left side sounds like epilepsia partialis continua, which points to cortical irritation rather than subcortical or deep capsular involvement. The pupils were approximately the same as they had been before, again suggesting some midbrain involvement, although pupillary inequality could occur with a cerebral lesion as a result of downward pressure at the midbrain and impingement upon the third nerve. That might occur with such conditions as tumor, cerebral hemorrhage or subdural hematoma. The electroencephalogram was of no help in localization on this last examination. The cerebrospinal fluid findings will be discussed later.

On April 20 an operation was performed. I presume this was an angiogram or ventriculogram or perhaps an exploratory craniotomy. Our diagnostic problem—the differentiation between cerebral vascular disease and cerebral neoplastic disease—is not an uncommon one in older people. If this was a cerebral vascular lesion, what type was it? Was it vasospasm? The earlier episodes were remindful of spasm, particularly with the prompt regression of symptoms. This man apparently had a labile blood pressure; on one occasion it was not too high, again it was considerably higher. On the third hospital admission the signs failed to clear, and he was left with a serious disorder.

Could this be the process that has been termed vasoparalysis? In this disorder there is supposed to occur weakening of arterioles under the burden of hypertension, the increased tension being ultimately transmitted to the veins, and there may be subsequent venous bleeding. This man might have had a small intracerebral hemorrhage into the cortex and not into the subarachnoid spaces or into the ventricular system. In favor of such a process is the hypertension. He was in the age group where he might have had arteriosclerosis. This was not the ordinary picture of massive intracerebral hemorrhage, there was no vomiting at any time and no blood in the cerebrospinal fluid, and also no increase in cerebrospinal fluid pressure. The rapid regression of signs in the early episodes would seem to weigh against a diagnosis of an ordinary cerebral thrombosis.

Could this picture have been the result of occlusion of the internal carotid artery? Certainly it might have been terminally. The arm is usually more involved than the lower limb and the syndrome may be transient. There may be intermittent paresthesias, there may be focal seizures, generalized seizures being uncommon. He may have had vascular spasm at first and subsequently internal carotid artery occlusion.

Was this cerebral Buerger's disease? Confusional episodes are common enough in this disorder. At first there might have been a transient character to the episodes. Seizures and hemiplegia may occur in cerebral Buerger's disease. Buerger's disease rarely involves the cerebrum and when it does it is not likely to remain so localized.

As far as neoplasm is concerned one would have to consider both primary and secondary cerebral tumors, and particularly meningioma. It is difficult to explain the initial period of sudden numbness and paralysis of the left arm on awakening if this be tumor. The suddenness of onset is against tumor as is also the rapidity with which the initial disorder cleared. After the first episode there was no progression for a period of some 9 months.

In favor of brain tumor was the clear localization and the increase in the final cerebrospinal fluid protein. The first two fluids contained proteins just at and above the high normal range, subsequently the cere-

brospinal fluid protein was 102 mg. per cent. A neoplasm might possibly do this. The pressure reading in the cerebrospinal fluid did not favor neoplasm. However, the mere fact that an operation was done adds to the evidence for a surgically approachable lesion, though we do not know if this operation was more than an angiogram. A localized hemorrhage may be attacked surgically. The patient's age does not help us in our consideration about brain tumor. With a cerebral neoplasm, particularly if it overlay the cortex or lay just subcortically, seizures might occur.

Against secondary or metastatic tumor is the duration; most patients with such a lesion do not live for a 15-month period, although it is not impossible. There was no report of a chest roentgenogram. I consider it poor medical practice in a case of this sort not to get a chest film. Perhaps it was obtained and the report has been omitted deliberately. Also, there was no description of the eyegrounds, almost as if they too might offer some clue to the pathologic process. The patient could have had papilledema, or he might have had severe retinal vascular change so that one could establish a more definitive diagnosis.

Could this be gumma or some other luetic variant over the convexity, such as syphilitic endarteritis or meningovascular syphilis? First, the serological studies were negative, but I have previously discussed a case in clinical pathological conference with negative serology in blood and cerebrospinal fluid and microscopic evidence of paresis. His age was against gumma which usually is seen in the earlier stages of lues. This man had headache and focal seizures compatible with the diagnosis of gumma. The duration of the illness is against gumma, and the fact that there was no increase in cerebrospinal fluid pressure is also a point against it.

Could this man have had a traumatic lesion such as subdural hematoma? I doubt it, although hematoma may be characterized by focal seizures and alternating periods of confusion and coherence. The onset on awakening in the morning is against it and there was no history of head injury but there need not be. As a rule the cerebrospinal fluid pressure is elevated. I doubt that a traumatic lesion is worthy of much consideration in this case.

There is a hemiplegic type of multiple sclerosis. This man was 60 years old. His age is against multiple sclerosis but in older patients multiple sclerosis is likely to be missed. The clinical picture does not resemble multiple sclerosis, although in some instances there may be seizures. In about 1 per cent of cases there is a seizure as the initial symptom, and there may be focal cortical lesions, but obviously multiple sclerosis would be highly unlikely.

Largely on the basis of the cerebrospinal fluid pressure findings, the relatively slow progression of this lesion, and the fact that he had hypertension with variations in blood pressure, I believe that he had a vasoparalytic condition. The Moniz syndrome of internal carotid occlusion as a terminal affair at the time of the third attack may have been the major catastrophe that lead to the operation.

Dr. Charles D. Aring: The students prudently discussed the neurological compendium in trying to arrive at a diagnosis in this case. Their final diagnoses were evently divided between tumor and vascular disease, 13 apiece; that is, if I could sense the final diagnosis in some instances. Of tumors, 8 felt that this was a glioma, 4 a meningioma, and 1 said that this was a neoplasm, which, I suppose, is good enough in this instance. Under the vascular heading, 9 felt that this was some form of cerebral arteriosclerosis perhaps with thrombosis, 2 that this might represent hypertensive encephalopathy, 2 that this was likely to be a subdural hemorrhage. The two students not herein recorded discussed everything but could not select a final diagnosis.

In some of the student discussions there was a rather plaintive plea for a history of trauma. We gave you what we had. That is the way it is in the practice of medicine in a general hospital; the patient is handed you and frequently you don't have much history and you must function nevertheless. Some students played about on the theme of crenated red blood cells in the cerebrospinal fluid. We used to think that crenated red blood cells in the cerebrospinal fluid meant

that these cells had been there a long time. We have given up this idea. It depends upon many things, upon the chemistry of the tube in which the cells are collected, how traumatic the tap has been and a lot of other variables. You can't rely on crenation of cells to tell you whether hemorrhage has been present in the fluid for a period of time.

In answer to Dr. Salzer's questions, a chest roentgenogram was not made prior to operation. The eyegrounds were on the whole not informative, there was some arteriosclerosis and mild arterio-venous nicking. It is usual in the technique of the clinical pathological conference to consider as normal any test or examination considered significant, that isn't mentioned in the protocol.

You might be interested in this patient's presentation at Neurology Grand Rounds on May 5, 1951, some two weeks after operation; I believe Dr. Salzer was conducting. Dr. Daniel Osher said, "The stuttering onset resulting in hemiparesis is suggestive of disease of the internal carotid artery. Angiography is indicated." Dr. Salzer said, "Vascular disease is the most likely etiologic basis; the type of seizure indicates an irritating cortical lesion."

I think perhaps we'd like to discuss the roentgen studies next.

Dr. Emanuel Levin: I did not see a calcified pineal gland in any of the films. Ventriculograms revealed no evidence of shift. The septum pellucidum was directly in the midline and the lateral ventricles were similar in size, showing a minimal degree of dilatation. There was no evidence of intracranial disease, as may have been revealed by changes in the ventricular system. The chest showed diffuse pneumonia involving the left upper and lower lobes. The right lung was clear.

Dr. Aring: This chest x-ray was on May 4 which was 2 weeks after operation. He went on with his pneumonia and inanition, dying on May 19.

Discussion of Pathology

Dr. Paul Wozencraft: The autopsy was performed 6 hours after death. Besides the lesions in the nervous system there was lobular pneumonia in the left lung, severe atherosclerosis of the left coronary artery and of the aorta, arterionephrosclerosis, acute cystitis, foci of necrosis of liver cells and of acinar cells of the pancreas, multiple extensive decubital ulceration, emaciation and dehydration. Blood cultures taken at autopsy were sterile.

The brain weighed 1285 grams. On the superior surface of the right cerebral hemisphere in those parts of the frontal and parietal lobes adjacent to the Rolandic fissure there was a depressed and shrunken area, soft to palpation. The center of this softened area was in the right parietal lobe, 3 cm. from the midline. The overlying leptomeninges were diffusely thickened, as they were also over the parasagittal portion of the left parietal lobe.

On the inferior surface of the brain the only abnormality noted was some brownish discoloration of the leptomeninges beneath the orbital surface of the right frontal lobe. The vessels of the circle of Willis were of large calibre and contained numerous atherosclerotic placques in all the major vessels but no thrombi were found.

Coronal sections of the brain revealed several areas of softening, an old one in the right basal ganglia and a more recent one about the superior aspect of the right fissure of Rolando. The former involved the lentiform nucleus, the island of Reil and the internal capsule, extending to the ependyma of the right lateral ventricle. There was no ventricular distortion anywhere. Grossly the overall measurement of this lesion was 2 x 1 cm. The age of this lesion was indicated by cavity formation, the cavity contained a meshwork of fibrous tissue.

The more recent lesion was near the midline in the right parietal and frontal lobes and it did not disrupt the continuity of the gray matter. There was a somewhat similar lesion of lesser obviousness in an analogous location on the left, which had not been evident in the inspection of the superficial surface of that hemisphere. The leptomeninges overlying these bilateral parasagittal brain lesions were considerably thicker than elsewhere.

Scattered particularly in basal ganglia, but also in white matter and pons were perivascular areas of rarefaction. These were

quite small. Congestion was obvious throughout the brain stem.

Microscopic examination added little, besides confirmation of the gross pathology of the brain. The lesion in the right basal ganglia was that of greatest age; it was largely cystic, the cavity containing a scattering of fat granule cells and fibroblastic strands, and the walls a moderate increase in astroglia.

The softening in the mesial (parasagittal) portion of the hemispheres was the typical stripe-like disorganization of the gray matter, in which the brunt of the process is borne by the second, third, and fourth cortical layers. This gray matter which had not appeared to be disrupted to the naked eye, showed vacuolization and appeared like a jig-saw puzzle pulled apart. In the second, third and fourth cortical layers one could make out few nerve cells and these were damaged; typical of the reaction was the universal swelling of astrocytes in these areas. The leptomeninges overlying were considerably widened by a finely fibrous network containing sparse nuclei. There was little acute cellular reaction in leptomeninges.

As in the gross sections, congestion was generalized, and perivascular spaces may have been widened a bit. Atherosclerosis was widespread but no occluded vessels were seen.

The most recent lesion appeared to be the result of partial deprivation of nutrition to specific cortical areas, since the tissue was not destroyed there evidently had been sufficient circulation to maintain some elements in it. The astrocytic reaction is typically that of partial deprivation of blood supply.[1] It appears that Jacksonian seizures did not supervene until the latest insult on April 19, 1951, and that they were in some way associated with the involvement of the mesial cortex of the right parietal and frontal lobes. Of course, it is difficult to pick out specific lesions and indict them with assurance, in a brain as generally involved in vascular disease as was this one.

It is a common failing here as well as elsewhere that the carotid system in the neck is not obtained at autopsy. Undertakers have not looked with favor on this procedure, and further it is a difficult thing to do routinely in a hospital of this sort with a very heavy autopsy routine. It adds at least an hour to the time of performance of an autopsy, which, in our laboratory overwhelmed as we are with work, we have not been able to spare. We will, of course, obtain the carotid system in specified cases henceforth. This autopsy was done before pathologists' attention was directed by Fisher[2] to the importance of the internal carotid artery in softenings of the brain. He presented several cases of infarction of the brain without evidence of thrombosis in cerebral arteries. Examination of the internal carotid arteries in the neck showed severe atherosclerosis, usually in the region of the carotid sinus with reduction of the lumen to a diameter of 1 mm. I also want to cite for the students particularly another article, that of Hicks and Warren.[3] They found infarctions without thrombosis in 60 per cent of brains in which the vessels were carefully studied. In the brain, as in heart and kidneys, complete obliteration of the lumen of a vessel is not required to reduce blood supply below a critical level. A vessel with its lumen reduced by atheroma may carry a satisfactory blood supply until the head of pressure falls, perhaps as a result of shock or spasm. If ischemia is prolonged infarction follows.

Clinical Diagnosis

Thrombosis of right internal carotid artery.

Lobular pneumonia, left.

Doctor Salzer's Diagnosis

(one month before death)

Thrombosis of right internal carotid artery.

Anatomical Diagnosis

Encephalomalacia due to circulatory disturbance, recent in mesial portions of both parietal and frontal lobes about the Rolandic fissure, old in the right basal ganglia and internal capsule.

Severe arteriosclerosis of cerebral vessels.

Severe atherosclerosis, left coronary artery.

Arterionephrosclerosis.

Acute cystitis.

Lobular pneumonia, left lung.

Multiple extensive decubital ulceration.
Emaciation.
Dehydration.

Dr. Aring: This patient would fit the clinical description of internal carotid artery occlusion. Even though we don't have all of the evidence, the case made a fine exercise since it isn't usual that patients with softening, even though it be cortical, have Jacksonian fits. That it happens we know; I don't know with what frequency. With repeated Jacksonian seizures such as this man had, the students and Dr. Salzer naturally worried about a removable lesion.

Dr. Daniel Osher: The problem of strokes without the finding of cerebral thrombi has been increasingly drawn to our attention. After the appearance of the article by Fisher[2] on internal carotid artery occlusion, we began to search for this lesion with angiograms. Of the small series that I've done personally, I've had perhaps a half-dozen proven cases of occlusion of the internal carotid artery in the neck, several of these have been confirmed at autopsy. I think this is the explanation of a large number of strokes. I think that eventually a goodly percentage of non-hemorrhagic stroke is going to be found to be due to internal carotid artery occlusion in the neck. In favor of this diagnosis is the so-called stuttering onset. These recurrent attacks are sometimes quite mild, and signs may last only a day. Blindness in the ipsilateral eye occurs quite infrequently. How does internal carotid artery occlusion result in only a brief attack of paralysis? I believe that's explained by the amount of anastomotic circulation. One may have a complete occlusion of the internal carotid artery in the neck without signs, one does exactly this surgically on occasion without producing neurological deficit. On the other hand one may get an area of softening somewhere out say in the distribution of the middle cerebral artery where there just wasn't enough collateral circulation from either the circle of Willis or between the terminal branches of the cerebral arteries. So with internal carotid artery occlusion in the neck we may see any variation in syndrome from a complete and massive hemiplegia with coma (and shift of the pineal gland due to softening of the brain on the ipsilateral side) to no signs whatsoever.

As far as palpating pulsations, I find it very difficult to evaluate the pulsations of the internal carotid artery. It is difficult to feel the internal carotid artery, and I don't think you can tell by this technique whether it is occluded or not. I think the only diagnostic answer is in angiography. Lately I haven't been doing angiography on many of these cases because at present there isn't much we can do about it by way of therapy. But to my own satisfaction at least I've proven that a fair percentage of cases such as that discussed this morning are due to occlusion of the internal carotid artery in the neck. Strangely enough this condition can occur in young people, a fact known for many years. I believe Fisher noted that the most frequent site for atherosclerosis in the human body is the first portion of the internal carotid artery just beyond the bifurcation, commoner than in the aorta which used to be thought to be the commonest site. So even a youngish person may get a focal area of narrowing at this point, and depending on his anastomotic circulation, may or may not develop signs and symptoms because of it.

Dr. Wozencraft: Is there any danger to angiography?

Dr. Osher: Yes, a small percentage of patients may develop either a transient or permanent hemiplegia. One has to use judgment in deciding where angiography may be helpful. I've had one case of permanent hemiplegia following angiography in perhaps 200 angiograms. I think we don't know the real cause of the trouble, it's supposed to be irritation to smaller vessels. If one uses 35 per cent diodrast in relatively limited amounts the danger may be obviated. One has to be careful about injecting clots that form in the system, in subsequent injections to the first.

Student: Is there any relation between hypertension and this syndrome?

Dr. Osher: I know that the syndrome occurs in old, arteriosclerotic people without hypertension. I have the feeling that it's more common in hypertensive patients.

Dr. Aring: Are you perhaps referring to the concept that the body in maintaining a steady state becomes "accustomed to" hypertension? Then if for any reason this pressure abruptly rises or falls, somehow with disequilibration of homeostasis thrombosis may occur? This is an idea that we have had, but I don't know proof for it. Surely some hypertensives operate in a narrowed margin of safety.

Dr. Osher: We do know that falling blood pressure in hypertensive patients, in some manner may be associated with the onset of a stroke. This is seen sometimes in surgical procedures where low blood pressure may have been maintained for a time and softening develop. It is conceivable in an area that has a narrow margin of reserve due to narrowing of vessels either in neck or brain that if the systemic pressure be dropped enough, circulation through such vessels may be inadequate.

Dr. Aring: Possibly the students do not know that in a fair number of patients who come into the hospital with coronary occlusion, the presenting signs are those associated with a hemiplegia, the so-called cerebral debut of coronary occlusion. In not a few instances we have missed the coronary occlusion by having our attention drawn to the hemiplegia. We know also that hemiplegia has occurred with massage of the carotid sinus in some old people.

Student: What was the reasoning that led to the ventriculograms?

Dr. Aring: This patient had a high protein in the final cerebrospinal fluid and he continued to have Jacksonian fits. When a person like this continues to have Jacksonian fits, you had better investigate the possibility of a relievable lesion since it represents a tragedy if one of them is missed. Would you agree, Dr. Espey?

Dr. Frank Espey: I can remember our problem with this man very clearly. We (the neurosurgeons) thought he had a subdural hematoma. The neurologist's views have already been remarked on, they had made a diagnosis of internal carotid artery occlusion.

Dr. Aring: I will mention again what I have reiterated previously in these conferences; the technique of the clinical pathological conference is somewhat different from handling the living patient. We have a lot of worries on the ward where you've got to keep your antennae out and be continuously on the alert. You have heard us tell about our clinical method, how we give every neurological case an intense moment of clear, cool thought, trying to discern whether or not there might be a relievable lesion present. This technique is considerably different than that of Dr. Salzer in discussing such a case a year later. We can be quite fanciful and theoretic and we can cover the waterfront in our discussions, mentioning everything and sundry; but when you're on the ward you have to come to the point. The patient's life may depend upon it. I am not one to argue with the neurosurgeon about burr-hole explorations, probably more of them should be done than we are doing. Since, as Dr. Osher said we can't do anything about internal carotid artery occlusion, I would agree with the diagnostic procedure pursued in this case.

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TRANSACTIONS OF THE GALVESTON NEUROLOGICAL SOCIETY

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FUNCTIONAL INTERPRETATION OF THE MECHANISM OF EXTRAPYRAMIDAL FUNCTION PROPOSED BY PAPEZ

GLENN V. RUSSELL, PH.D.

Advances in recent years in our knowledge of the structure and the connections of central motor mechanisms require a re-evaluation of the probable mechanism of extrapyramidal function. Because the extrapyramidal system does not function independently, but rather acts upon other parts of the motor mechanism in the brain it is necessary to review the systems which contribute to the motor activity of the intact animal. The pyramidal system, including the corticospinal and corticobulbar tracts, provides for the direction of phasic volitional motor actions, and also provides a constant activity for the maintenance of muscular tone and posture. The parapyramidal systems are considered to include the cortico-ponto-cerebellar and dento-rubro-thalamo-cortical pathways which act in the initiation and the supervision of volitional motor activity, and the postural and tonic mechanisms (including tectospinal and rubrospinal, vestibulo- and reticulospinal, and corticoreticular tracts). The extrapyramidal system is described as including two principal circuits through the basal ganglia—one to the cortex and the other to the cerebellum.

The corticonigral tract arises from area 4s and 6 and goes to the substantia nigra. The nigrostriatal tract joins the substantia nigra to the caudate nucleus and putamen. The striatum gives rise to the striopallidal fibers ending in the globus pallidus. From this point two pathways appear. One is the fasciculus thalamicus (H_1 of Forel) passing to the caudal part of the ventral anterior nucleus of the thalamus, and then to the premotor cortex. The other pathway is the ansa and fasciculus lenticularis. These fibers, forming H_2 of Forel, course caudally to terminate in the zona incerta, subthalamic nucleus, and prerubral field (H of Forel). Impulses descend through these structures into the red nucleus and adjacent tegmentum (nucleus profundus mesencephali) and are relayed via rubro-reticulo-olivary and tegmento-olivary pathways through the inferior olivary complex to the cerebellum. These connections form the mechanism of extrapyramidal function proposed by Papez.

It is established that the action of the extrapyramidal system is inhibitory in nature, and it is shown that two anatomical pathways may function in a normal animal. One pathway exerts its influence upon the motor and premotor cortex and the other upon the cerebellum. It is further suggested that tremor at rest and the incoordinated movements of chorea and ballismus result from the release (loss of extrapyramidal inhibition) of the pyramidal system. Tremor at rest results from overaction of the constant component of pyramidal activity, while choreic movements result from release of excessive phasic activity of the pyramidal system. In both

From Department of Anatomy, University of Texas, Medical Branch, Galveston.

cases neuronal circuits through the basal ganglia back to the cortex via the thalamus would be involved. Postural alterations of athetosis and spasticity or rigidity of Parkinsonism follow release (altered afferent innervation) of cerebellar areas resulting in abnormal cerebellar innervation of cortical and brain stem parapyramidal centers. In this instance the neuronal circuits involved are through the basal ganglia to the red nucleus, tegmentum, inferior olive, and cerebellum.

Discussion

Dr. Donald Duncan: Dr. Russell's exposition is not only an excellent review of the anatomy of the basal ganglia and their connections but it also presents a thought provoking and lucid theory on the interrelations of pyramidal, parapyramidal, and extrapyramidal systems. Since he has utilized the very latest information on the fiber systems arising from and entering the basal ganglia, particularly the nigrostriatal system of fibers, I think we can assume that this formulation of the overall activities of the motor systems is more nearly correct than any of its antecedents. Attention should be directed to the inseparable nature of the pyramidal and extrapyramidal systems and as a result how misleading the ideas of paleo- versus neo-systems can become.

The suggestion of initiative and supervisory functions for the cerebro-cerebellar connections in volitional activity is new to me and it raises the question of volitional movement in cerebellar agenesis and other massive losses of cerebellar tissue. Another question is how to reconcile the theory of a circuit from the pallidum via the ventral anterior nucleus of the thalamus with the usual explanation that this nucleus is without known cortical connections?

Dr. Russell: The concept of parieto-ponto-cerebellar connections in relation to voluntary motor activity, often referred to as the "ideo-motor plan mechanism" is an important one in the volitional motor mechanism. In cases of cerebellar agenesis, it must be realized, the individual developed his volitional mechanism without this system, probably by substitution. After massive cerebellar loss, rehabilitation might well occur following a similar substitution. However, I am advised that in both types of cases a definite deficiency in volitional ability can be demonstrated. My use of the ventral anterior nucleus of the thalamus as the terminus of the fasciculus thalamicus rests upon a morphological subdivision of this region of the thalamus differing slightly from that of Walker and others. It is the caudal portion of this nucleus to which this fiber system passes, and this region corresponds with the more rostral portions of the ventral lateral nucleus of Walker, for which cortical connections are well known.

Dr. Irvin M. Cohen: In most discussions of the pathophysiology of extrapyramidal disease, attention seems to be focused on the motor phenomena. In Dr. Russell's paper it is sought to explain the mechanism of the kinetic aspects, but it does not explain the concomitant autonomic manifestations so commonly observed.

Dr. Russell: In addition to the mechanisms for somatic motor activity there exists a well developed, although less well described or understood, mechanism for visceral motor activity. This latter mechanism has important regulatory centers in the hypothalamus. An extensive system of pallido-hypothalamic fibers exists providing a direct connection between the basal ganglia and the hypothalamus. Certainly a lesion of sufficient size to cause somatic motor disabilities would be expected to alter the functioning of the visceral motor mechanism.

Dr. Neville Murray: In any discussion of the function of the extrapyramidal system it is usual to consider both the distribution as well as the regulation of muscle tone. Clinically we see in a disease such as Parkinsonism an increase in tone differing in distribution as well as character from lesions of the motor cortex and its projection fibers in that it affects all muscles but is often greatest in the trunk and the neck in contrast to the extrapetal phenomena in the limbs characteristic of hemiplegia. I was wondering if Dr. Russell's theories might shed any light on these problems of distribution? Dr. Russell has seen fit to omit any discussion of the phylogeny of the extrapyramidal system. I would like to ask whether the corpus striatum achieves its greatest size relatively speaking in reptiles and birds?

Dr. Russell: The latter question first. Yes, it is said that the striatum reaches its greatest relative size in reptiles and birds, but the great increase in neopallial structures in the mammals, in particular in the primates, make inference from such comparisons extremely difficult. Distribution problems, I think, do not present difficulties for the theories here discussed. I do not want to take the time to go into this phase in detail, but might suggest that the bulk of motor cortical areas deal with the innervation of the extremities and thus lesions in cortical areas would be evidenced by more prominent extrapetal signs. Conversely the extrapyramidal system is closely related to the postural and tonic mechanism (in part) and this system deals more with the trunk musculature than with that of the extremities. Recall, however, that many extrapetal signs are observed in extrapyramidal system pathology.

CEREBRAL CORTICAL "INCLUSIONS" IN PSYCHOSES

MELVIN SCHADEWALD, M.D.

The material for this study was obtained by biopsies removed from the pre-frontal cortex at the time of open pre-frontal lobotomy. Thirty-four biopsies thus obtained from psychotic human patients were subjected to the staining methods described by Papez in 1944. This method consists essentially in selective chemical removal of those cellular entities masking or blocking visualization of the specific "inclusions." All the cases were studied in relation to an apparent developmental sequence of the granules in which the "inclusions" appear first within the cerebral cortical nerve cell cytoplasm, are then extruded into the interstitium where they appear either free or within glial cells, and finally these entities come to lodge in the perivascular cells or in the cells of the vessel walls. Commonly, a morphologically similar granule is found within the inner layers of the leptomeninges.

During the process of extrusion of the granules from the cytoplasm there is a progressive fragmentation and disappearance of the cytoplasm. In its final stage a residual condition of many naked nerve cell nuclei results. On the basis of these observable sequential changes, criteria were established by which the "inclusion" evidence denoted early quiescence in three cases (9%); early active in four (12%), active in twelve cases (35%); advanced quiescence in eight (24%); and in seven (21%) the histopathologic conditions were judged as being advanced and active.

The presence of these particular granules in these biopsies confirm the presence of those reported by Papez but a more cautious judgment of the significance of these granules is indicated than has prevailed heretofore. Three possibilities present themselves: these granules represent structures indicating an infectious process; or, these granules represent a change as a result of some disturbance in energy metabolism; or, these structures "normally" exist in pre-psychotic or non-psychotic cortical nerve cells and a significant "inclusion" change may or may not presage or precipitate a psychotic episode.

Further work that is indicated was discussed and the difficulties of completing a definitive study were considered. There is as yet no adequate reported similar series of control biopsies from the frontal lobes of the non-psychotic human patients. A second deficiency is related to a lack of clinical correlation with morphologic facts and stems from deficient or absent longitudinal histories, correlations with previous therapy and a lack of a consistent diagnosis by psychiatrists for the individual patient. A third deficiency is inherent in this presented study in the fact that a total cytochemical evaluation has not been made and no correlation is possible as yet with those changes which may be present and related in other nerve cell cytoplasmic organelles.

From the Department of Pharmacology, University of Texas, Medical Branch.

Discussion:

Dr. Irvin Cohen: Dr. Schadewald warns against prematurely deriving definitive conclusions without further study. One of the obvious dangers lies in applying *post hoc* logic to the data at hand, i.e., inclusion bodies in brain cells of psychotics equals etiology of psychoses. Nonetheless, I think such investigation represents a healthy trend. Our present "knowledge" concerning the genesis of psychosis is at best a body of working hypotheses and much information remains to be brought out. Most of us derive a certain amount of internal security as therapists by regarding our particular concept of psychosis as teleological but we should face the fact that this may not be so.

Dr. Ira J. Jackson: I think that this presentation by Dr. Schadewald is excellent and certainly deserves much consideration. I think one of the most impressive features is that Dr. Schadewald himself realizes the deficiencies from his own preliminary studies and I know that he is going to correct these as time goes on. It would seem to me that the cytochemical approach to this problem is most promising and may in the future give us a better idea of what goes on in some of our psychically and intellectually aberrant patients. We are doing all we can in neurosurgery to increase the control series of "non-psychotic" cerebral cortical biopsies as they fortuitously become available.

Dr. Glenn V. Russell: The description Dr. Schadewald has presented of "inclusions" within the cortex of human psychotic patients appears to confirm the original conclusions of Papez. More recently Papez reported that these "inclusions" are a form of encephalozooid for which he proposes a long and complex life cycle and suggests that they represent the etiological agent of psychoses. Having seen phase contrast demonstrations in Papez's laboratory of freshly prepared slide cultures of his material, I can state that some rather unusual "structures" are observable. Their accurate description and classification has been set forth by Papez. My own observations, however, are too limited to be able to comment further on the conclusions that he has drawn. In regard to controls, Papez has stated that in a few cases of "probably" normal cortical material, no "inclusions" could be demonstrated.

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